

NAVAL POSTGRADUATE SCHOOL

Monterey, California



THESIS

**DESIGN CONSIDERATIONS TO BE
ADDRESSED WHEN DEVELOPING WEB BASED
APPLICATIONS FOR SENIOR MANAGERS**

by

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September 1998

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BASED APPLICATIONS FOR SENIOR MANAGERS**

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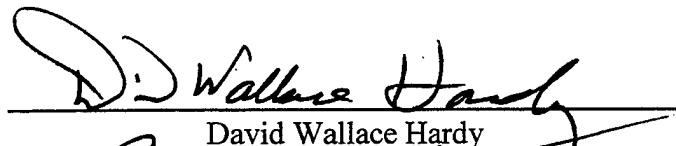
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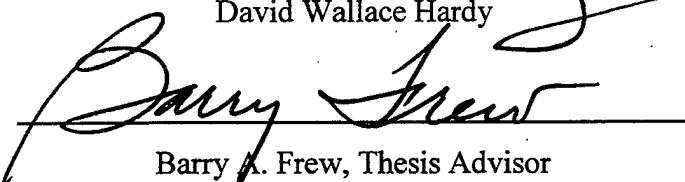
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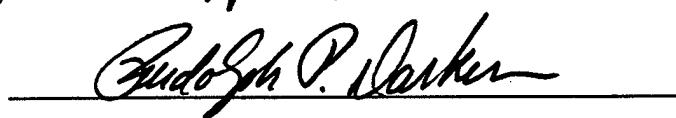


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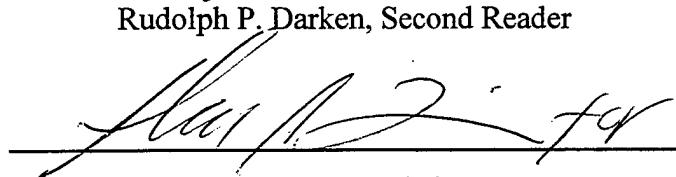
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ABSTRACT

This thesis develops guidelines for building Web sites that are useful to senior managers in two ways. First, these managers can obtain information from or pass information to a site in order to accomplish tasks more effectively and efficiently. Secondly, the senior manager must be able to go to a site and use that site without being required to undergo instruction or read manuals before using the site. Web technology is in place to assist these managers in performing at a higher level. Methodologies used in this thesis combine a study using sample web sites, based on the Center for Executive Education Web Site, two surveys, database connectivity, and usability design practices to aid in Internet or intranet based applications. This document contains results from surveys of senior managers that are evaluated to select a suitable methodology for designing Web sites specifically for this subset of users.

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I. INTRODUCTION

As networks and the Internet become standard tools in manager's toolkits, the usability of the applications' interfaces will be a critical factor in their success. The American Heritage Dictionary defines *usability* as "in a fit condition for use," with *use* being defined as "the application or employment of something for some purpose." The term usability has been used to describe the way in which an application presents itself to the user.

Users want to get their information quickly. They like well-organized sites that make information easy to find. (Morkes and Nielsen, 1997) Organizations must build sites that are more than status symbols. Most users are under some time constraint, either real or personally imposed. Two important reasons users are willing to use applications are 1) to gain information from data and 2) the way the information is presented to the user. This information must provide some benefit to the user and it must be presented in an easy to understand and intuitive way.

The information presented to any user comes from data that is distilled and analyzed for trends or patterns. This data must come from some repository, which in most cases is a database. Database management systems must have the ability to communicate with applications to aid in automation of provision of data to be analyzed.

A. OBJECTIVE

This thesis develops guidelines for building Web sites that are useful to senior managers in two ways. First, they can glean information from, or pass information to the site in order to accomplish their tasks better and more efficiently. Second, the senior

manager should be able to go to a Web site and intuitively use that site without having to read a manual or obtain instruction before attempting to use that site. These managers can make better use of their time than needlessly searching manuals or receiving instruction. This technology should be in place to help these managers perform at a higher level. Furthermore, they will not resent using this technology to pull useful information from the Internet or intranet.

This thesis focuses on two main areas: the first being usability and design of a Web Site, and secondly, connecting database management systems (DBMS) and Web based applications. Together, these ideas enhance a Web site's capability to become a more useful tool for everyone involved with its use.

B. RESEARCH QUESTIONS

Primary research questions include:

1. What are the issues involved with building senior manager interfaces?
 - What is "user friendliness" – both from the senior manager's standpoint and the site builders stand point?
 - Why should site builders/administrators be concerned with user friendliness?
 - What are the lessons learned from this experiment?
 - Can this study transcend boundaries to other Navy managers, or private industry CEOs and managers?
2. What are the issues with respect to connecting an ODBC database to a Web page to provide the data to the interface, once it is properly designed?
 - What are the technologies for linking an ODBC Database to a Web page?
 - Web tool
 - Database tool
 - Connecting or communication tool
 - Where are these technologies moving? (i.e. what is on the horizon?)

- Can a useful (i.e. automated) Web page be created without the use of browser "plug-ins" for those using the Web page from outside the organization?

C. SCOPE AND LIMITATIONS

The scope of this thesis on interface issues for senior managers focuses on analyzing and developing the Leading Change in the Information Age (LCIA) Web site with usability in mind, and analyze using these techniques in a real world scenario. The scope on databases is to identify technologies most useful in linking databases with web pages. A case study is used to describe the current state of the LCIA Web site to test senior management users in an attempt to profile their behaviors in relation to computer usage. Information gathered will be used to suggest guidelines for creating applications which they are more willing to use, and which are more intuitive. Qualitative rather than quantitative methods are appropriate for this project, since the number of participants in the study was limited to nine. Little literature exists relating senior managers and usability. Therefore, surveys involving direct interaction, interview, and observation were given to assess the interaction with technology.

This study is important because of the lack of previous data collection and analysis in this context. Participants in the study were students in the July/August LCIA class. The researcher made every effort to construct survey questions that were neutral, so as not to bias responses.

D. THESIS ORGANIZATION

This thesis consists of five chapters. Chapter II provides a background of the organization used in the case study, and provides explanation of the need for such a

study. Chapter III presents the methodology used to obtain study data and information for this project. Chapter IV describes the study and findings relating to the use of ODBC databases and Web sites and findings on usability in relation to the responses of the senior managers using the LCIA site. Chapter V provides a summary, conclusions, and recommendations for areas of future research and suggestions for increasing the usability of the LCIA site.

II. BACKGROUND

How many times have you seen computer systems sitting on a desk, in the back corner buried under a mountain of paper and dust? Upon inquiry as to the reason for the non-use of the system, the answer is usually, "because we were not trained on the system and we can not figure it out ourselves." Systems can be so difficult and cryptic to operate, that users are repelled from using the system, and the organization has wasted its money on a highly priced paperweight. Users often give up on trying to use a system because of the arcane interface and cantankerous nature of the system.

Senior managers are no different. Senior managers do not have the time to go through training courses to learn a system, because that is generally not their primary function: Senior managers use computer systems to transform complex data into usable information so they can make intelligent decisions about how to perform their role, or to enhance the organization's mission. Systems such as decision support systems and executive support systems or executive information systems can make these decisions in a more informed way, and much quicker. But these systems will not help anyone if they are not utilized. Therefore, systems must be designed with all users in mind.

In the same vein, systems will certainly not be utilized if they do not present accurate or pertinent information. Information presented in these interfaces must be rooted in fact. These facts often come in the form of raw data, which is usually contained in a database. ODBC addresses the issue of letting the user application communicate with the database quickly and easily, without requiring a programmer to code each

individual Web based application. This can severely impact the ease of use and attractiveness of these applications.

A. THE CENTER FOR EXECUTIVE EDUCATION

The Center for Executive Education (CEE) is part of, and located at, the Naval Postgraduate School in Monterey, California. The courses taught here are intended to address senior defense managers' needs relating to the expansion of existing ties with industry and other organizations and institutions, and to study emerging technologies, practices, and policies in order to enhance the capabilities of DoN/DoD systems, commands, people, and information. The population the Center is geared to serve consists of military Officers with the ranks of O-7 through O-9, and their civilian executive counterparts. The center is "exclusively dedicated to enhancing the knowledge and understanding of leaders within the Department of the Navy (DoN) and Department of Defense (DoD) who will be making critical decisions affecting the nation's readiness in this complex and rapidly changing environment" (CEE, 1998). To provide this educational experience, the center provides executive level education programs that "furnish the tools and skills necessary to add value to senior defense leaders" (CEE, 1998). The Center offers a variety of courses including: Leading Change in the Information Age (LCIA), Revolution in Business Practices (RBP), Topsail, and the Chief Information Officer Program. The latter two of these programs are under development at the time of this writing.

This thesis uses the LCIA program as its test bed. The focus of the LCIA program is to increase the problem solving ability of senior defense executives in

performing their leadership roles in information superiority. The goal is to make participants more familiar with:

- Development and maintenance of sound integrated technology infrastructures and application systems
- Application delivery and operation
- Tools and methods used to monitor and evaluate performance of installed warfare systems
- Resources and how to use them for optimal effect

The material is concentrated on the underlying principles of technologies and on the ability to analyze and synthesize effective and flexible strategies. The intellectual framework consists of two components:

- An architectures, systems, and technologies component, and
- An information policy, strategy, evaluation, and operations component.

Both components aim to provide a comprehensive understanding of information. (CEE, 1998)

B. THE LEADING CHANGE IN THE INFORMATION AGE PROGRAM

The LCIA Program specifically serves O-7 and O-8 Officers and their civilian equivalents. The second course for 1998 was conducted at the Center from 26 July through 14 August. Parts of the curriculum for this program are designed to familiarize the participants with current technologies in order to assist them in their jobs. The Internet and the World Wide Web, or simply the Web, are used to full advantage to help these people gather information on a myriad topics related to their jobs. Topics of

interest to these individuals are very diverse, ranging from political to technical, and anything in between. The course helps participants learn how to access and filter the deluge of information available on the Web today. The Internet can be useful for gathering data from databases to be fed into applications, such as decision support systems (DSSs), used to create information deemed useful to making decisions for the future.

C. INTERFACE DESIGN

1. Reading on the World Wide Web

In order to design interfaces geared toward Web based clients, one must first study how users read from that medium. According to the Nielsen Norman Group, "User experience" encompasses all aspects of the end-user's interaction with the organization, its services, and its products.

The first requirement for an exemplary user experience is to meet the exact needs of the customer, without fuss or bother. Next comes simplicity and elegance that produce products that are a joy to own, a joy to use. True user experience goes far beyond giving customers what they say they want, or providing checklist features. In order to achieve high-quality user experience in a company's offerings there must be a seamless merging of the services of multiple disciplines, including engineering, marketing, graphical and industrial design, and interface design. (Nielsen Norman Group, www.nngroup.com/about/userexperience.html, August 14, 1998)

These statements can easily be applied to any government scenario, where the customer is analogous to any user of an organization's Web site and references to the company equate to the organization using a Web site for constructive purposes.

A study conducted by John Morkes and Jakob Nielsen found that 79 percent of test users scanned any new page they came across, with only 16 percent reading word-for-word (Nielsen, 1997a). Four possible reasons for this particular behavior are (Nielsen, 1997b):

- Reading from computer screens is tiring and approximately 25 percent slower than reading from paper;
- The Web is a user-driven medium, i.e. users feel they must move on and click on things;
- Each page has to compete with literally millions of other pages for the user's attention;
- Modern life is hectic.

According to research by Nielsen and others, individuals do not want to invest too much time in any one page while searching for information on the Web because the page may not contain the needed information. Thus, the page is quickly scanned for relevance in a quick once over before clicking on to the next page.

Other important issues are the credibility of the information, since there is no guarantee about who has provided the information posted to the Web site. Studies by Nielsen have shown that by providing hypertext links to external related sites, using high quality graphics, and employment of good writing practices, credibility or perceived credibility of the information on a site can be significantly increased.

2. Writing for the World Wide Web

By understanding how users interface with and read on the Web, insight can be gained into methods of effective writing for the Web. Information should be presented in a concise and intuitive format (Gahran, 1998). Keep pieces short, by breaking up if plausible and follow these guidelines (Gahran, 1998):

- Pare down whatever you are saying to the greatest extent that is appropriate. Consider using bulleted lists and highlighted key words.
- Make sure every bit of content has a point that will matter to the user, and make those points obvious.
- Break up longer stretches of text into manageable “chunks”.
- Attempt to predict and answer all the major natural questions that your users will probably have about your organization or your site’s content. Consider dropping any content that does not focus on what the user probably wants to know.

Writing for the Web is more akin to newspaper journalism than to any other form of distributing information, including marketing publications, magazine articles, books or theses. In the newspaper format, the summary or conclusions of the story are at the front of the story. This is done in order to immediately capture and retain the reader’s attention. If the reader reads these lines and is interested in the topic, they will read the entire article to retrieve details. This is especially true for the front page in the area known as “above the fold.” This prime real estate must be used to full advantage to make the sale by hooking the potential customer with interesting facts in order to entice them to purchase the paper. In the same vein, each Web page on a site must make promise of the information contained therein, as well as in the lower “drill-down” layers. The most sought after information should be summarized or encapsulated at the top of the page, in the writing style described above. The user will scan this page and determine if it contains the information needed, and read further or drill-down further for more details. Nielsen (1996) refers to this type of writing as the inverted pyramid style. This allows the page creator to identify the purpose of the site near the top of the page so the reader can easily see if they want to invest time at that site.

Creating hyperlinks in text serves to highlight that text and to provide a place so the user can drill-down to obtain more information, as desired. This is one of the most powerful features of the Web, and this is what creates the “webbing” effect of the Internet. This allows Web writers to split their writing into smaller, coherent pieces to avoid long scrolling pages (Nielsen, 1996). Scrolling will be discussed later in this thesis.

In their paper, *Concise, SCANNABLE, and Objective: How to Write for the Web*, Morkes and Nielsen describe a study they conducted which started with a control version of a test site and modified the content into the three categories and one final category which combined characteristics of the three. The modified versions fared better than the original version containing marketing jargon or “marketese”. The concise version had promotional writing style but the text was much shorter, with only the more important information being retained. The “scannable” version also contained some marketese, but used bulleted lists, boldface text to highlight key words, photo captions, shorter sections of text, and more headings to encourage scanning. The objective version was stripped of all promotional language, presenting information without exaggeration, subjective claims, or boasting. The combined version had shorter word count, was formatted for scannability, and was stripped of marketese. For overall usability, the concise style scored 58 percent better than the control, the scannable version was judged to be 47 percent better, and the objective sample was 27 percent better according to the study. The combined version scored 124 percent better than the control version. (Morkes and Nielsen, 1997) This study statistically proves that investing in good writing practices designed specifically for the Web definitely pays dividends. A common thread between

conciseness, scannability, and objectivity is that each reduces the user's cognitive load, which results in faster, more efficient processing of information. Concise text contains less information to process; scannable text calls attention to key information; and questioning the credibility of promotional statements seems to distract users from processing the meaning of that information. (Morkes and Nielsen, 1998) While military sites may not be selling goods, they can use these practices to communicate important information to users without shunning them or wasting their scarce time.

In the past, programming Web pages required no formal training. A developer need only be familiar with hypertext markup language (HTML) syntax. This often resulted in pages with content that was lifted directly from promotional literature, not necessarily suited to Web documents or to a particular Web page to which it was posted. With usability and readability becoming a higher level concern to Web users, the Web site editor will become increasingly influential in future Web site management. Three types of editor will emerge: editors-in-chief will keep the site focused on the customer, or intended audience. This editor will keep the writing true to the form discussed above. There will also be a second-tier editor, whose job it will be to integrate any new pages, or additions to pages, into the site as a whole, to retain site identity and continuity and validate information in relation to context. The third type of editor will be a so-called "content gardener", who will regularly comb through old content on the site and either delete it or bring it up-to-date (i.e. keeping links current). (Gahran, 1998)

3. Designing for the Web

After the writing style issue has been sufficiently covered, graphic presentation is the next item to be addressed regarding site or page construction. The core principle is: never forget for whom the page is being designed. As a general rule, do not design Web pages, or sites for that matter, specifically for the commanding officer (CO), chief executive officer (CEO); or some executive steering committee, unless they will actually be the only users of that site, as is the case for this thesis. The key point here is to design for the actual intended user of the site.

One of the requests users continually make is to have faster response time when using the Web (Nielsen, 1997c). According to Nielsen, the basic advice regarding response times has been the same for almost thirty years (Nielsen, 1994):

- **0.1 second** is about the limit for having the user feel that the system is reacting instantaneously, meaning that no special feedback is necessary except to display the result.
- **1.0 second** is about the limit for the user's flow of thought to stay uninterrupted, even though the user will notice the delay. Normally, no special feedback is necessary during delays of more than 0.1 but less than 1.0 second, but the user does lose the feeling of operating directly on the data.
- **10 seconds** is about the limit for keeping the user's attention focused on the dialogue. For longer delays, users will want to perform other tasks while waiting for the computer to finish, so they should be given feedback indicating when the computer expects to be done. Feedback during the delay is especially important if the response time is likely to be highly variable, since users will then not know what to expect.

Anyone who has used the Web lately knows that sub one second or even sub ten second response times will not be available anytime soon, especially when dialed in over a modem. At times, this is even the case for those connected directly to a local area network (LAN). Web site developers must be cognizant of this limitation and design

accordingly. Figure 1 shows the distribution of users in relation to their connection speed to the Internet.

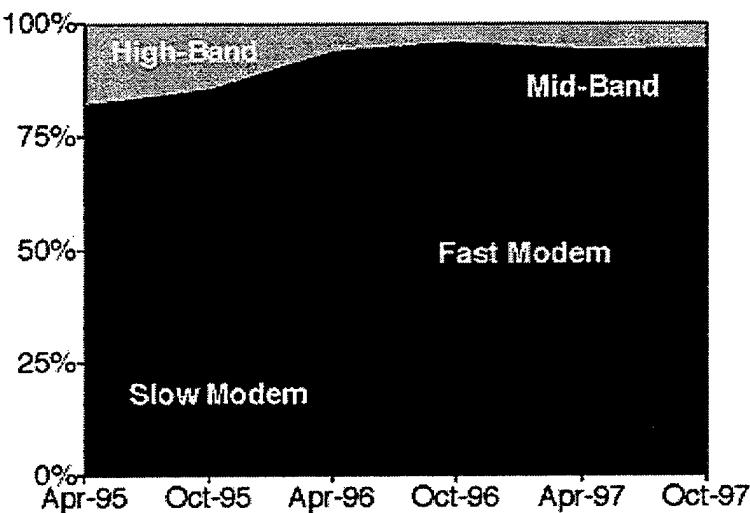


Figure 1. (Source: Nielsen, 1997c)

While the ratio of users connecting with slow modems (14.4 Kbps) is shrinking in proportion to the number connecting with fast modems (28.8 to 33.6 Kbps), the overall number of modem users remains approximately constant for the period covered. With high speed access not being widely available until at least the year 2000 (Berst, 1997), speed of download must continue to be the number one concern of graphic designers.

Components that impact and delay response times the most according to a newspaper article from the Seattle Times Web site are (Williams, 1998):

- Pages that appear on the screen quickly. Do not load them up with big graphics.
- No sound files that start running without asking if it is wanted first.
- No blinking, animated graphics, or dancing objects.
- No frames dividing up the screen (frames will be discussed later in this thesis).

- Keep the buttons in the same place as you move through the site. These buttons should be logical and well labeled.

Graphics and images are usually the largest parts of any Web page, and as such they tend to use up the most bandwidth. Omitting some or all graphics from a page is the quickest and easiest way to decrease download time of a Web page, although some smaller, well chosen graphics may make the page more readable. Graphics to be placed on a Web page should be chosen carefully. They must add value to the information that the page is being used to convey, not just be placed there for decorative purposes. Consider that if a page contained ten 100KB images, the download amount would be over one megabyte of information. This certainly does not bode well for those using a modem connection.

Another tip for designers to consider is the use of alternative or the “ALT=” attribute. This allows the user to have a description of an object while it is loading into the browser. If the transfer is interrupted or “times out”, the user will know if the item is something they are interested in trying harder to obtain, either by reloading the page or returning later to download it again. This also describes objects to those who have image loading turned off in their browser, or those who have browsers that do not support images. Values set in this attribute should be a sensible description of the object they represent. There are four types of images contained on Web pages; page toys, navigation icons, supplemental or interesting, and those that are critical for understanding the page. (Flavell, 1998)

Templates are one easy way to ensure continuity of design for a Web site. However before implementing a template, it is necessary and advisable to test the

template for its usability. One way to test the usability of the template without involving the usability of the content (which should be tested separately) is to "greek" the page. This concept, described by Nielsen (1998), involves replacing all words on the page with unintelligible nonsense. This forces readers to rely on the inherent communicative aspects of the layout to perform the test task. In the test, each user is given a set of "greeked" pages and asked to identify various parts of the page (i.e. main content selections for the page, page title, person responsible for the page, etc.). (Nielsen, 1998) This tests the overall graphic design of the page, without involving content.

In his May 1996 Alertbox column, Jakob Nielsen, a noteworthy usability expert, gives his top ten recommendations for Web design:

- **Using Frames**
 - Users can not bookmark the current page and return to it (the bookmark points to another version of the frameset).
 - URLs stop working.
 - Printouts become difficult.
 - predictability of user actions disappears .
- **Gratuitous Use of Bleeding-Edge Technology**
 - Don't try to attract users to your site by bragging about use of the latest web technology.
 - Mainstream users care more about useful content and your ability to offer good customer service.
 - Causing the user's system to crash while visiting your site deters further visits.
 - Do not use newer technologies until some experience has been gained with respect to the appropriate ways of using the new techniques.
- **Scrolling Text, Marquees, and Constantly Running Animations**
 - Never include page elements that move incessantly.
 - Moving images have an overpowering effect on the human peripheral vision.
 - give your user some peace and quiet to actually read the text.
 - Do not use the <BLINK> tag.

- **Complex URLs**

- Users try to decode the URLs of pages to infer the structure of web sites.
- Users do this because of lack of support for navigation and sense of location in current web browsers.
- URLs should contain human-readable directory and file names that reflect the nature of the information space.
- Users sometimes need to type in a URL, so try to minimize the risk of typos by using short names with all lower-case characters and no special characters (many people don't know how to type a “~”).

- **Orphan Pages**

- All pages should include a clear indication of the Web site to which they belong.
- Remember, users may access pages directly without coming in through your home page.
- Every page should have a link up to your home page as well as some indication of where they fit within the structure of your information space.

- **Long Scrolling Pages**

- Only 10% of users scroll beyond the information that is visible on the screen when a page comes up.
- All critical content and navigation options should be on the top part of the page.
- Note added December 1997: More recent studies show that users are more willing to scroll now than they were in the early years of the Web. I still recommend minimized scrolling on navigation pages is still highly recommended, but it is no longer an absolute must.

- **Lack of Navigation Support**

- Don't assume that users know as much about your site as you do.
- Users need support in the form of a strong sense of structure and place.
- Start your design with a good understanding of the structure of the information space and communicate this structure explicitly to the user.
- Provide a site map and let users know where they are and where they can go.
- Good search features are needed since even the best navigation support will never be enough.

- **Non-Standard Link Colors**

- Links to pages that have not been seen by the user are blue; links to previously seen pages are purple or red.

- Do not change these colors since the ability to understand what links have been followed is one of the few navigational aides that are standard in most web browsers.
 - Consistency is key to teaching users what the link colors mean.
- **Outdated Information**
 - Budget to hire someone to maintain the information of the Web site as part of the team.
 - Most people would rather spend their time creating new content than on maintenance.
 - Maintenance is a cheap way of enhancing the content on your website since many old pages keep their relevance and should be linked into the new pages.
 - Some pages are better off being removed completely from the server after their expiration date.
- **Overly Long Download Times**
 - Traditional human factors guidelines indicate 10 seconds as the maximum response time before users lose interest.
 - It may be acceptable to increase this limit to 15 seconds for a few pages, only if absolutely necessary.
 - Even Web sites with high-end users need to consider download times.

Other considerations are to include the date the material on the page was written, as well as the date on which the page was last updated. These enhancements will lend to the credibility of the page and site.

Web sites must be designed for the lowest common denominator. This means that every user must be able to access the site, no matter what browser they may be using. Fancy applets and programs should not be included on the page for this reason, as well as slowing download time. Furthermore, the user should not be required to install some plug-in just to use your site. This will turn users away, and they will not use the system. Any additional functionality needed or desired on the site should be done on the host's server.

4. Designing for an Intranet vs. an Internet

Just as intranets and Internets serve different purposes, so do the resident pages on those respective systems. As discussed earlier in this thesis, a developer must keep the purpose of the page in mind at all times. An intranet and its pages are generally geared toward a subset of users; employees familiar with the organization, its structure, terminology, and special circumstances. Internet site users are not as familiar with the organization. The tasks, type and amount of information, and bandwidth and cross-platform needs differ between intranet and Internet users. An intranet will contain more sensitive information related to the day to day running of the organization, like human resources information, draft reports, project progress reports, etc. This Internet site will generally contain public information, like customer support items or general command information. (Nielsen, 1997d) The same tenacity should be displayed for designing intranet pages as for Internet pages, with continuity of design and purpose for respective areas being observed. Bandwidth is usually less of a concern in the intranet environment, so restrictions on graphics use in that respect are relaxed, although it is still not advisable to include graphics merely for the sake of including them.

III. METHODOLOGY

A. SURVEY METHODOLOGY

After consideration of the various methods of data collection for research, surveys and direct observation were determined to be the best procedure for this project. Surveys are one method to determine how subjects react to factors being studied. Participants of the July/August 1998 LCIA class were given two surveys, and were directly observed while taking the interactive portion of the second survey. Participants of the class were a diverse group of flag officers with equally diverse amounts of computer use experience. Data gathered in this thesis is intended to provide qualitative analysis of the senior management user in order to make recommendations to be used in the design of user interfaces of applications specifically aimed at this subset of users. The nine participants of the LCIA class did not provide a sufficient base on which to do quantitative analysis, however interesting conclusions could be drawn from the information gained.

1. General Survey

The first survey was given in an attempt to assess the amount of integration of the computer into the lives of senior managers. The intent of this survey was to profile the senior management user. By determining the level of familiarity of the target group with current computer technology, a baseline can be established by determining the least common denominator. Questions in both this survey and the subsequent survey were designed to be as neutral as possible to determine the true user's perspective.

The 5 basic characteristics of questions and answers that are fundamental to a good measurement process (Fowler, 1995):

- Questions need to be consistently understood.
- Questions need to be consistently administered or communicated to respondents.
- What constitutes an adequate answer should be consistently communicated.
- Unless measuring knowledge is the goal of the question, all respondents should have access to the information needed to answer the question accurately.
- Respondents must be willing to provide the answers called for in the question.

How to design questions to measure subjective states (Fowler, 1995):

Because there are no standards against which to evaluate the correctness or rightness of answers, standardization of the stimulus of the question is particularly critical in measuring subjective states. For this reason, designing questions that can be administered in a consistent way and that mean the same thing to all respondents, to the extent possible, is high on the list of strategies for creating good measurement of subjective states.

Equally important is standardizing the response task. That means clearly defining the dimension or continuum respondents are to use in their rating task and giving them a reasonable way to replace themselves, or whatever else they are rating, on that continuum.

Fowler continues, the answers that come from a subjective question have no absolute meaning, rather they are relative. The position of the answers relative to each other is where the relevant information is found. In general, surveys should ask things that respondents are able to reliably report.

The first survey included general demographic questions about user characteristics to determine what the subjects had access to, and what they were used to using. There were also some questions based on a five point Likert scale (Fowler, 1995)

regarding Web sites on the Internet itself, as well as questions relating to the time and amount of time spent on electronic mail and Web access. This survey was handed out to the participants on 11 August 98 and collected the next day.

2. CEE Specific Survey

The second survey was designed to ascertain input about the CEE Web site specifically. Questions were asked after the group had opportunities to use the site. The first section of this particular survey was a set of general questions about the site based on a five point Likert scale. The second part was interactive, in which participants were shown Web pages from two sample sets, asked questions about these pages, and directly observed. This portion was executed on a one-on-one basis, with the pages being accessed for the individual in an attempt to standardize the exercise. Participants were not asked to go to the site and find out answers to specific questions as in the study by Morkes and Nielsen (1997) on usability. This study concluded that by writing in a concise, objective, and scannable format, designers can greatly increase usability of a Web page.

In order to assure anonymity, no names were taken and the data shall be displayed only in aggregate form. Appendices 1 and 2 show the general survey and the CEE survey, respectively, while raw summary data are shown for each respective survey in Appendices 3 and 4.

B. THESIS METHODOLOGY

The usability portion of this thesis required the aforementioned surveys. The CEE specific survey required the creation of two sample sets of web pages. The entire LCIA

Web site was selected for this project. A dummy or test database was created to mirror the actual database. This test database was linked to the Web application using ODBC drivers. The original pages were then modified to interact separate from the actual site to avoid interference with that site's operations. As they were modified, each file name was appended with the string 'tango' to delineate it as the pseudo-original site. Next, the pages for Sample Two were reworked according to principles suggested by the literature review on usability, most notably by Jakob Nielsen in his paper, *Top Ten Mistakes in Web Design* (Nielsen, 1996b). These file names were appended with the string 'test'. All pages were affected, some more heavily than others. Major redesign took place on the registration page, in particular.

The LCIA class was chosen to participate in this experiment due to their credentials. They were an ideal target group to query, since they fit the senior management and user criteria and they were on-site. This contributed to the ability of the researcher to control the experimental conditions.

Information gained from the participant's answers will be compared to information on usability obtained in the literature review to determine if the same principles may apply to this elite subset of the user community. Certain standard features and methods have been found to be useful in increasing usability of system interfaces. These methods can be used as a set of guidelines to enhance usability of online systems. There was little available information on usability of online systems, with the exception of one source. Jakob Nielsen's information on usability was used extensively in this thesis. Few other related readings agreed with and closely matched the primary site for information gathering.

The purpose of this thesis is to determine issues related to connection of an ODBC database to a Web based application and to delve into the usability of such a system. Information on the database portion was found in sufficient quantity through a literature review and direct observation of the implementation of an application on the CEE Web site.

IV. STUDY AND FINDINGS

A. ANALYSIS OF SURVEY OF LCIA PARTICIPANTS

1. Introduction

The author conducted a survey of the participants of the LCIA Course as described in the "Survey Methodology" section of Chapter Three of this thesis. The survey was conducted near the end of the three-week course. This was found to be advantageous because, as two participants noted, they may not have had the skill set to answer the survey early in the course. The survey was deemed to be self-explanatory, but the author was available to answer any questions. An early question concerned the meaning of intuitive. As found in the American Heritage Dictionary, *intuitive* is defined as of, pertaining to, or arising from intuition; with *intuition* being the act or faculty of knowing without the use of rational processes; immediate cognition. Participants returned nine of the nine surveys given out.

The general survey attempts to profile the type of work life the senior manager leads, especially in relation to using computers and computer-related products and applications. This survey is included as Appendix A and the data collected are listed and summarized in Appendix C. The CEE site specific survey asks the participants specific questions about the Web site for the Center for Executive Education. This survey tests the usability of the site in the opinions of this subset of users. The CEE survey is included as Appendix B, with the lists and summary of data collected is Appendix D.

2. General Survey

The senior managers tested in this survey spend an average of 11.06 hours per day at work, ranging from ten to twelve and one-half hours per day. In addition to these work hours, the participants indicated they spend one to two hours daily on work related activities in addition to the workday hours above, averaging one and one-half hours per day.

All of the respondents indicated using a computer at work, with eight of nine doing so at home and seven of the nine using mobile computers. All reported using personal computers (PCs), thirty-three percent use a Macintosh, four of nine use a notebook computer, and two of the respondents indicated using a palm top computer. Seventy-eight percent use Windows 95, forty-four percent for Windows NT Server, thirty-three percent for Windows NT Workstation, and none reported using Unix Workstation. Browser use was split fairly evenly with six of the nine using Microsoft Internet Explorer (MSIE) and five of the nine using Netscape browsers. Obviously some of the respondents use two different browsers, but obtaining preference was not the goal of this question. Seventy-eight percent use Microsoft Office '95 or '97. The SIPRNET secure network is used by five of the nine respondents and NIPRNET unclassified network is used by six out of nine participants.

Activities performed on computers include: E-mail and Web access or Web browsing being performed by all respondents; word processing and presentation graphics being used by eighty-nine percent of participants; financial programs are used by five out of nine; four responses were registered each for spread sheets and an "other" category which required a write-in response; one individual uses DoD applications; and sixty-

seven percent play games on the computer. Write-in responses were FOCIS management package, a program to aid in learning to play the piano, E-commerce (electronic commerce) and human resources applications, and financial transactions.

The users surveyed ranged from one to two Navy electronic mail accounts and from zero to one private account. They receive thirty electronic mail messages each per day and an average of eleven attachments to the electronic mail per day, with an average of one of these attachments being unreadable for some reason. Four of nine participants spend sixteen to sixty minutes per day on average reading, generating and responding to electronic mail, with the remaining five spending one to three hours daily on these tasks.

Time spent on the Internet was equally divided at forty-four percent each spending zero to thirty minutes and thirty to sixty minutes daily respectively, browsing or searching the Web for any purpose, and eleven percent spending one to three hours daily on these activities. Forty-four percent indicated they browse or search the Web several times daily, thirty-three percent once daily, and twenty-two percent classified themselves at less than five times per week. Seventy-eight percent spend two to ten minutes on a Web site once they reach it, eleven percent spend zero to two minutes, and eleven percent spend ten to thirty minutes at a site once they get there. Table 1 shows the ranking for actions taken once the respondents are finished looking at a Web site.

Method	Mean Rank	Overall Rank
Follow a query-retrieved suggestion	3.00	4
Jump to another Web site without using a link	1.86	1
Follow a link to another Web site	2.00	2
Close the browser	2.57	3
N/A, I do not access the Web *(Can be thrown out – no responses given)	*	*

Table 1. Most Popular Actions Taken When Finished Viewing a Web Site

Each user was asked to rank order common web page problems which detract from the page's usability the most. Table 2 below shows the overall results to this question.

Detractor	Mean Rank	Overall Rank
Long download times	1.56	1
Long scrolling pages	2.78	3
Scrolling text, marquees, ads, constantly running animations	4.44	6
Counter intuitive links	3.67	4
Lack of navigation support	3.89	5
Non-standard link colors	5.89	7
Poor color schemes	6.44	8
Other, please write below *Other = Broken links	2.00*	2

Table 2. Ranking of Most Distracting Features of Web Pages

These data seem to confirm Nielsen's points about Web design. It also verifies that senior managers want many of the same things as the users in Nielsen's usability tests.

Participants were asked to agree or disagree to the following statements on a five-point Likert scale. The results are shown in Table 3.

Statement:	Completely Agree	Generally Agree	Neutral	Generally Disagree	Completely Disagree
The complexity of a Web sites address discourages me from visiting/using that site:		3		5	1
Computers make me more productive:	3	6			
Computers increase the number of tasks I must complete to the extent that I experience increased workload		2	3	1	
Expanded use of E-mail would make me more effective/efficient	1	5	2	1	

Table 3. Responses to General Statements about Web Sites.

The complexity of a Web site's address does not seem to be a factor detracting from respondents' use of a Web site. Overall respondents at least generally agree that while computers may increase workload, they are a desirable tool for getting work accomplished.

General questions were asked in which participants could write in responses. The first of these was to list three Web sites they like and to give the reasons why. Seven responses involved news related sites like CNN, the Weather Channel, the Washington Post site and ZDNet, while six participants specifically listed CEO Express. The reoccurring comment for the CEO Express site was that it contained good links to many other sites of interest. There were two references to search engines, due to the wealth of information possible there. Other sites that were not preferred were shunned because of broken links, promise but no substance, gratuitous graphics, most news sites for not being interactive, and search engines for being low yield. Other sites were singled out for requiring too much time to find the desired information (i.e. non-intuitive sites), non-

current information, too much advertising, and sites that were not connected or hyperlinked.

3. CEE Specific Survey

In the first section of this survey, participants were asked to respond to a set of statements specifically regarding the CEE Web site. Responses were given on a five-point Likert scale as seen in Table 4.

Statement:	Completely Disagree	Generally Disagree	Neutral	Generally Agree	Completely Agree
Information on the site is relevant:	5	4			
Information on the site is accurate:	3	4	2		
Information on the site is complete:	3	4	1		1
Information on the site is current:	3	2	3	1	
Information on the site meets my needs:	3	6			
Information on the site is intuitive:	4	2	2	1	
Information on the site is easily readable:	6	3			
The site address is too complex:	1	1			3 4
The amount of page scrolling is acceptable:	1	5	2		1
The link colors are acceptable:	2	5		1	1
The colors used throughout the site are acceptable:	2	6			1
The amount of graphics is acceptable:	1	4	3		1
I would like to see more graphics:	1	3	3	2	
Download times are acceptable:	3	5	1		
Navigation support is acceptable:	5	3	1		
Navigation through the site is intuitive:	3	4	2		

Table 4. Responses to Section I of the CEE Specific Survey.

Responses to the questions regarding link colors and colors used on the CEE site included two outliers. Comments included an indication that the respondent could not tell by the colors used if they had followed a link, or not. The respondent also indicated that the

dominance of the color blue on the CEE site was objectionable, but made no further suggestion.

During the interactive or second portion of the survey the participants were shown two sample Web pages that were at essentially the same level of the site. The user was asked questions about the samples. Figures showing the set of samples for each question accompany the results here.

The first set of samples refers to the LCIA page shown in Figure 2 and Figure 3.



Leading Change in the Information Age

Next Class: 26 July - 14 August 1998

Participant Information (during the course)

- Schedule in calendar form
- Detailed Daily Schedule
- Local Activities
- Participant Biographies
- Uploading (sharing) files
- Downloading presentations / shared files

Needed Data:

- Profile Assessment Forms
- Participant Opinion Forms

Participant Information (pre-course)

- What to expect
- Hotel information
(Reservation deadline: 26 June 98)
- Car rental
- What to wear
- Orders
- Message Center

About the LCIA Program

- What this program offers
- Who should attend
- When and where
- Costs
- Faculty

Program Registration

Your inputs:

- Course registration form (please complete this form first)
- Course Planning Survey
- Transportation Plans
- Professional Biography

Figure 2. Sample 1 of LCIA Page (Top Portion Only).



The Course:

The faculty and staff of the center are committed to profoundly improving your understanding of emerging strategic and policy issues in conjunction with the opportunities and constraints provided by the information age. This transformation will require significant effort on your part, meaningful interactions with your colleagues, and an inquisitive dialogue with the faculty.

Some functions where your presence will be expected will be scheduled in the evenings ([course calendar](#)).

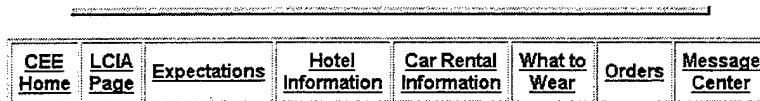


Figure 3. Sample 2 of LCIA Page (Entire Page).

When asked, seventy-eight percent of respondents preferred Sample Two, with the remaining 22 percent preferring Sample One. Sixty-seven percent judged Sample Two to be both more readable and more intuitive. Furthermore, six of nine indicated that Sample Two makes it easier to obtain information about the LCIA Program.

The next set of questions referred users to the samples shown in Figure 4 and Figure 5.

Leading Change in the Information Age

Content Overview

The focus of this program is to increase the problem solving ability in information superiority of senior defense executives in performing in their demanding leadership roles. The goal is to make participants more familiar with:

- Development and maintenance of sound integrated technology infrastructures and application systems.
- Application delivery and operation.
- Tools and methods used to monitor and evaluate performance of installed warfare systems.

The material is concentrated on the underlying principles of technologies and on the ability to analyze and synthesize effective and flexible strategies. The intellectual framework consists of two components:

- Architectures, systems, and technologies component and an information policy, strategy, evaluation, and operation component. Both components aim to provide a comprehensive understanding of information.
- Resources and how to use them for optimal effect.

The format used for this program is to provide half-day modules which use readings and lectures to drive discussion, case study analysis and practical exercises aimed at providing solutions to provocative questions or real-life situations. It includes a balanced mix of experienced practitioner and academic views. Participants meet with several industry representatives to learn about new and existing technologies.

[Course Calendar \(including topics\)](#)

[Return to the LCIA Page](#)

Figure 4. Sample 1 of Content Overview Page (What).



Content Overview

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The format used for this program is to provide half-day modules which use readings and lectures to drive discussion, case study analysis and practical exercises aimed at providing solutions to provocative questions or real-life situations. It includes a balanced mix of experienced practitioner and academic views. Participants meet with several industry representatives to learn about new and existing technologies.

CEE Home	LCIA Page	Participants	Schedule/Location	Costs	Faculty/Staff
--------------------------	---------------------------	------------------------------	-----------------------------------	-----------------------	-------------------------------

Figure 5. Sample 2 of Content Overview Page (About LCIA).

Eighty-nine percent preferred Sample Two and thought it was more readable, with the remaining eleven percent choosing Sample One. All participants, nine of nine, chose Sample Two as being more intuitive and making it easier to obtain information about cost.

Next, participants were asked to judge which sample made it easier to navigate from the Content Overview page to the Course Registration Form and why. Two of nine preferred Sample One, six of nine preferred Sample Two, and one stated that they were equally bad. When asked why, respondents choosing Sample One cited one less mouse click or fewer steps to get there and that it was more readily, easily available. Sample Two was touted for being more intuitive (two responses) and easier to read, the obvious selection, less scrolling, and three responses cited the registration icon, "it is easier to navigate from 'buttons' than narrative text", and the navigation bar taking the participant

to "Register" whereas Sample One requires searching. The "equally bad" response was qualified with the indication that Sample Two had too many mouse clicks and Sample One was too hard to find and required scrolling. One click to the registration page would have been the ideal state for this respondent.

The sample registration forms used for the next set of questions are shown in Figure 6 and Figure 7.

Registration
All information provided will be used for official course purposes only.

Course

<input type="radio"/> LCIA98-1	Feb-Mar 98
<input type="radio"/> LCIA98-2	Jul-Aug 98
<input type="radio"/> LCIA99-1	TBD
<input type="radio"/> LCIA99-2	TBD

Personal data

First Name

Middle Initial

Last Name

Informal Name for Nametag

Rank

Service

Job Title

Organization

SSN

Organizational data

Figure 6. Sample 1 of Course Registration Page (Top Portion of Page Only).



Registration

All information provided will be used for official course purposes only.

Course

Class	Dates	Class	Dates
CLCIA98-1	Feb-Mar 98	CLCIA99-1	TBD
CLCIA98-2	Jul-Aug 98	CLCIA99-2	TBD

Personal data

First Name <input type="text"/>	Middle Initial <input type="text"/>	Last Name <input type="text"/>
Informal Name for Nametag <input type="text"/>	Rank <input type="text"/> O-10	Service <input type="text"/> USN
Job Title <input type="text"/>		Organization <input type="text"/>
SSN <input type="text"/>		

Organizational data

Figure 7. Sample 2 of Course Registration Form (Top Portion of Page Only).

Six of nine chose Sample Two as being easier to navigate and easier to use, three chose Sample One. The same margin preferred each sample respectively, with six choosing Sample Two and three for Sample One. Comments received include Sample Two having less scrolling and bolder boxes. Two of nine indicated Sample One was more readable, while seven of nine preferred Sample Two. One of nine chose Sample One as more intuitive, seven chose Sample Two, and one indicated that the choices were the same. All nine participants preferred the drop boxes used for the "Rank" and "Service" entries and agreed that they were easier to use. Two of nine would prefer drop boxes for the state entry, while seventy-eight percent would not like to see drop boxes for state entries

qualified with comments like, "too many entries to scroll through", "list too long", and "I can easily type two letters."

One question asked which view of the "About LCIA Page" or "Content Overview Page" from Sample Two (Figure 5) the users preferred. The choices were the MSIE view and the Netscape Communicator view, with the only difference between the two being the font used. The MSIE version used Arial and the Netscape version used Times New Roman. One hundred percent chose the Arial version stating that it was larger type, even though no change was made to font size. One participant preferred the application's buttons better in Netscape Communicator, but when asked to consider the Web page only and not the application execution itself, that participant chose the Arial version as well.

Only one of nine would like to see the schedules presented differently. That user suggested putting a "click on a date for detailed daily schedule" note at the bottom of the page or on each week's row, in addition to the note to this effect at the top of the page. Delineating the start time for each day in the overview, or general, schedule was also suggested.

When asked what the users found most detracting about the CEE Web site, the most popular answers were too much scrolling noted by three respondents, and two respondents noted missing biographies on some of the staff and faculty members. Four participants made mention of having difficulty discerning which opinion forms they had completed and may like to be able to review previously entered answers. Two users would like to see larger font size. One participant said, "I like the wealth of information added on Sample Two...the more the better. On the current site, it looks like more information is available than really is." All responses can be seen in Appendix D.

4. Concluding Remarks

Even though both samples contained the same information overall, Sample Two was preferred. This can be traced to the graphic design of the page. Sample Two was designed based on the previously discussed usability information. The pages were kept simple and as short as possible. The registration page was designed to resemble a paper form and includes more white space. According to the surveys, senior managers want simple, readable, intuitive, and easy to use Web pages. It is imperative that designers of pages and sites intended for use by senior managers follow design principles discussed in this thesis. Interfaces must be intuitive and readable due to the lack of time these managers have or are willing to invest to learn how to use an interface. A site that is designed according to these principles will allow senior managers to use that site without referring to manuals or having to attend courses for instruction. This will prevent the Navy, and civilian institutions, from wasting money building Internet or intranet applications that are not used at all or not used to their fullest capacity.

Senior managers are far more interested in the content contained on the pages than in graphic wizardry, or so called "bells and whistles." This underscores the necessity to practice good writing habits and good design practices when designing reports and applications. These items should be presented in a brief, encapsulated form, graphically if possible.

B. ODBC

Since senior managers are interested in the content of a page or site, it is important for developers to present information of interest to the target user, not just data. Data is

raw vocal, numerical, written, or observed facts about a specific topic, whereas information can be defined as the product of processing and combining data to generate facts which may pertain to multiple topics (Surovchak, 1998). Figure 8 shows the relationship of these two terms.

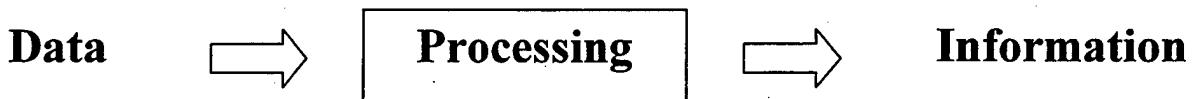


Figure 8. Relationship Between Data and Information (Surovchak, 1998).

Information is something that is useful to someone when making a decision, whereas data is just a compilation of numbers that has not had usable knowledge extrapolated from it yet. ODBC becomes important here because it creates the possibility of creating numerous dynamic Web pages, which also creates the opportunity to create sites that are rich in data, but poor in information. These pages can be powerful because they ride on top of databases with data that is itself dynamic, but it is important for these pages to present viable information. Senior managers do not want data that they must process themselves, that is the function of an information system.

1. Definition

Open database connectivity (ODBC) is a standard database access method developed by Microsoft Corporation. The goal of ODBC is to make it possible to access any data from any application, regardless of which database management system (DBMS) is handling the data. ODBC manages this by inserting a middle layer, called a database driver, between an application and the DBMS. (PC Webopaedia, 1997) This layer translates data queries from the application into commands that the DBMS can

understand. Both the application and the DBMS must implement the ODBC standard, or be ODBC compliant, in order for this system to work. This means that an application must be capable of issuing ODBC commands and the DBMS must be capable of responding to them. Figure 9 shows the relationship of applications, data stores, and ODBC.

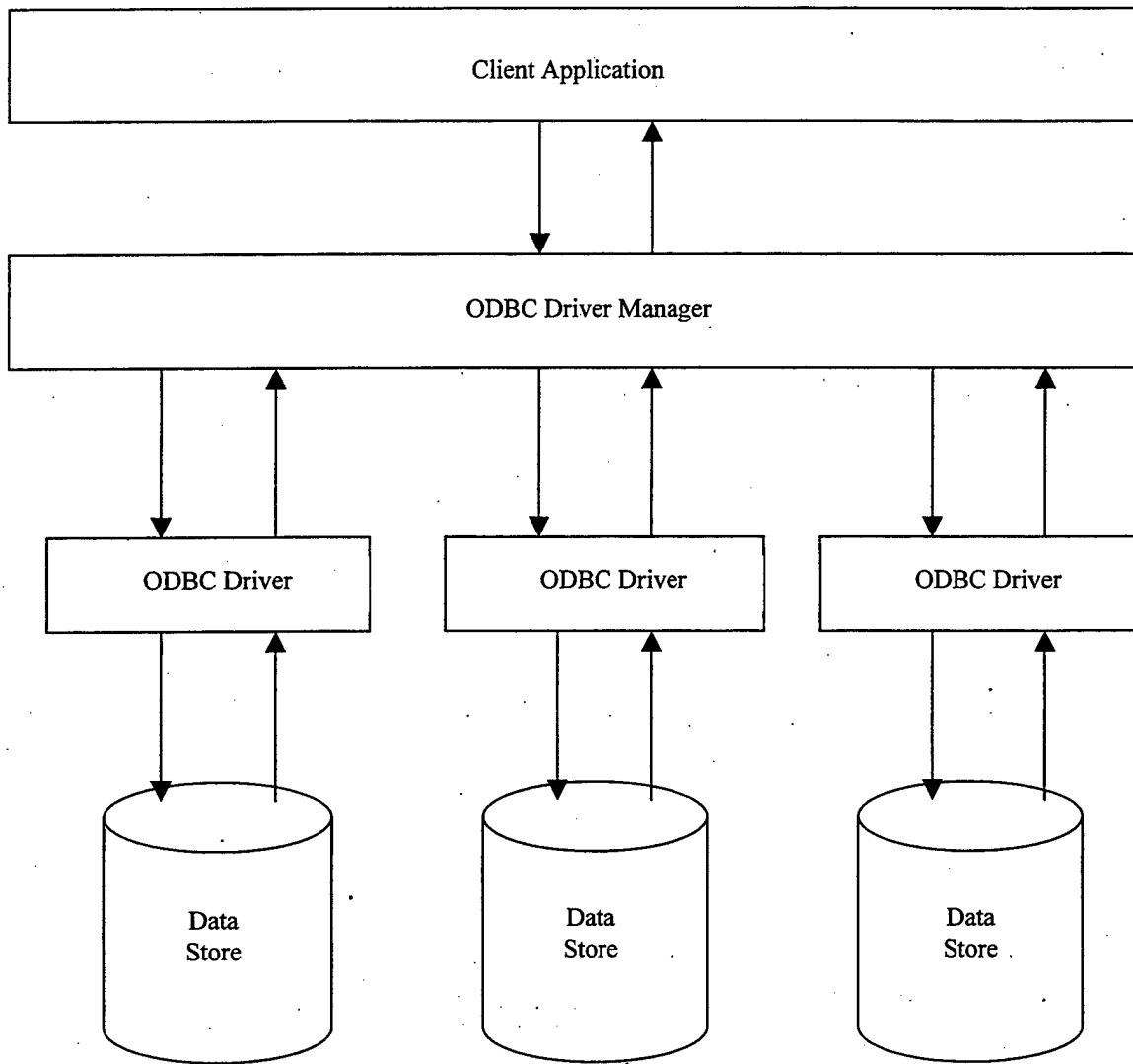


Figure 9. ODBC Model. (Adapted from Forta, 1998.)

2. History

ODBC was created in an attempt to allow Microsoft Excel to access diverse data stores. In April 1988, a Microsoft employee proposed a model that used database drivers to isolate the native data types of different database applications. This model, using application program interfaces (APIs), would allow client software to communicate with

any message store. To access a particular data store, all that would be required was a driver designed specifically for that data store. Four other companies were working on a similar project during this time, and between 1988 and 1992 these companies worked together to shape one specification. After undergoing several name changes, ODBC 1.0 was released in September 1992. (Forta, 1998)

3. How ODBC Works

ODBC facilitates access and manipulation of information by end-users in a manner congruent with their roles within an organization. The ODBC standard from Microsoft provides a transparent database independent interface between desktop based productivity tools – spreadsheets, work processing software, graphics packages, report writers, etc. and data sources such as relational DBMS engines. (Kingsley) The ODBC interface allows maximum interoperability between applications and back-end database management systems. An application developer can develop, compile, and ship an application without targeting a specific DBMS product. Users can then add modules called database drivers that link the application to their choice of DBMS.

Referring again to Figure 9, the primary purpose of the ODBC driver manager is to load and track drivers that actually implement ODBC function calls. The drivers perform ODBC function calls and interact with the data source. To obtain this functionality, the driver manages the communication protocols between the application and the data source when the application requests to connect to the data source. Once this connection is established, a driver is capable of handling requests to the DBMS that are made by the application. The driver also provides the necessary data translations to and

from the data source, and returns the results to the application. Furthermore, a driver will also standardize the error codes that are returned to it so that an application that is using multiple drivers will not have to manage discrepancies. (Signore, 1995)

Figure 10 below shows the basic flow of control for ODBC applications:

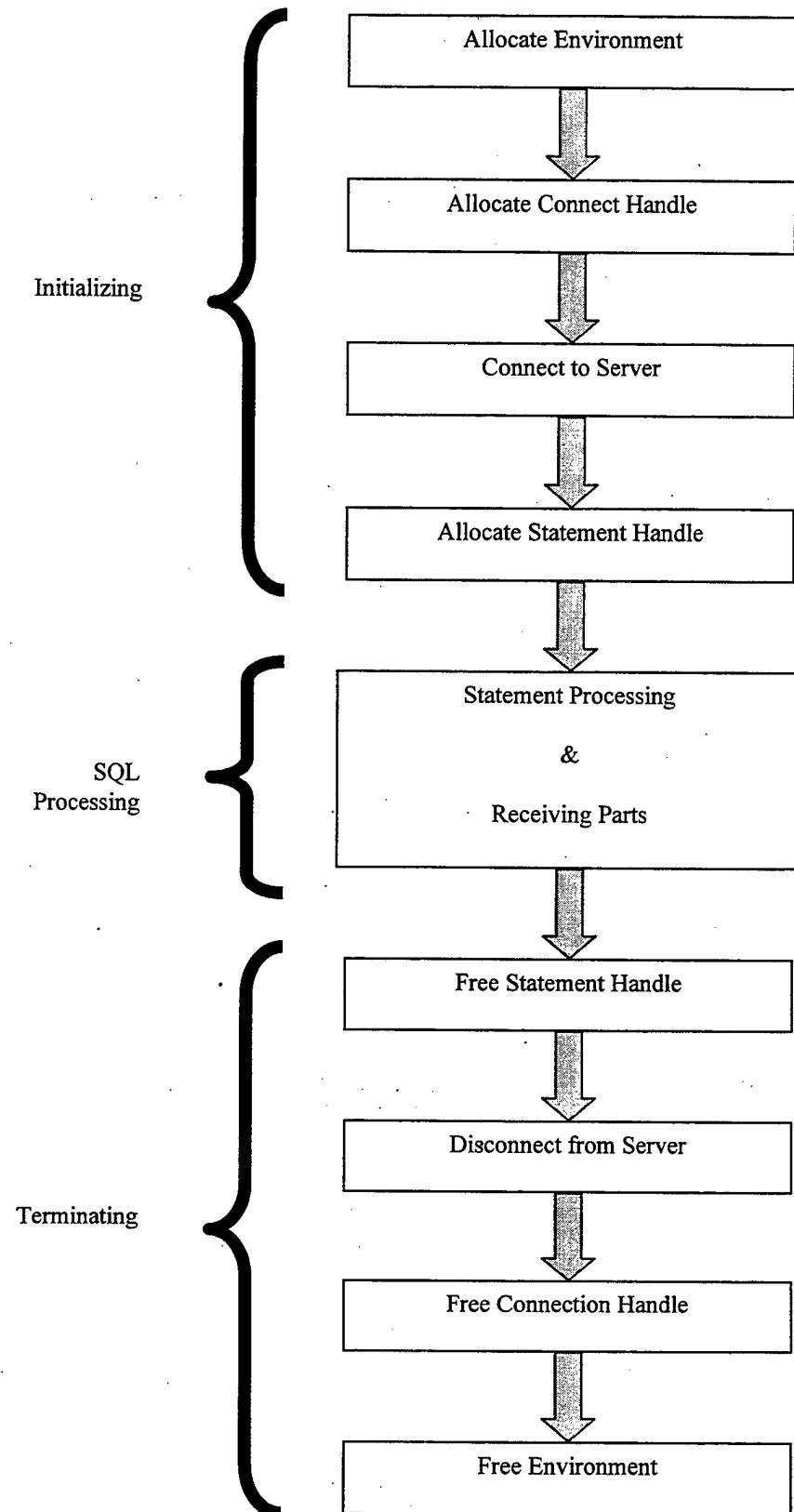


Figure 10. Basic Flow of Control for ODBC Applications. (Signore, 1995)

ODBC uses standard query language (SQL) to interact with databases. This language, designed initially by IBM, has become the industry standard for manipulating data in a database. Many of the programs available today have query builders or "wizards" that help the user to graphically define a query by dragging and dropping items they wish to manipulate.

4. Implementation

Many commercial-off-the-shelf (COTS) products support the ODBC standard. There are a plethora of products from which to choose, including spreadsheets, word processors, graphics programs, and many database management systems. For the CEE Web site, the following products were used: Microsoft Access, Cold Fusion, and Windows NT Server.

Microsoft Access is a scalable relational database and DBMS that integrates data from spreadsheets and other databases. It can share information over intranets and the Internet. Access is part of the Office 97 Professional suite of software from Microsoft, which is specified in the Commander in Chief, Pacific Fleet (CINCPACFLT) message regarding Information Technology for the 21st Century or "IT-21" (CINCPACFLT, 1997). Access is ODBC compliant, and the included Wizards make it easy to create databases and applications.

IT-21 is a Navy initiative agreed upon by CINCPACFLT and Commander in Chief, Atlantic Fleet (CINCLANTFLT) to standardize commands under these areas of responsibility to a consistent set of software and hardware products. This strategy will allow reduction of training costs and compatibility concerns. The goal of IT-21 is to link

all U.S. forces, and eventually even our allies, together in a network that enables voice, video, and data transmissions from a single desktop PC. This will allow warfighters to easily exchange information that is classified or unclassified, and tactical or non-tactical. To do this, a system must be built to industry standards, using commercial off-the-shelf technology (COTS), devoid of systems that do not communicate, in a client-server environment that allows the user to pull information needed in a way that is seamless to the user in the field. (Clemins, 1998) This means Access 97 should be available at many commands as a basic part of the software inventory, and no additional purchase would be necessary.

Allaire Corporation's Cold Fusion is a rapid application development tool that enables a designer to integrate browser, server, and database technologies into Web-based applications. It allows creation of dynamic Web applications and interactive Web sites. Cold Fusion uses any ODBC compliant database as a data source, can generate and receive electronic mail using simple mail transfer protocol (SMTP)/post office protocol (POP), includes file management capabilities, supports structured query language (SQL) queries, and can be managed and administered from any Web browser located anywhere with Internet access.

Windows NT Server, from Microsoft, is a server operating system for building and hosting Web based applications. This allows a server to reply to hypertext transfer protocol (HTTP) requests from browsers, perform security and user authentication, encrypt Web pages, and perform server side processing.

Using ODBC is merely a matter of ensuring products that can communicate with DBMSs are in compliance with the ODBC standard. In the case of the CEE Web site, all

of the products are ODBC compliant. If the right software is installed on the server, a developer can design and implement databases. If proper ODBC drivers are installed, developers can register newly created databases with the Cold Fusion software. All of these administrative tasks are aided by graphic user interfaces that allow the user to browse directories and access online help functions. Cold Fusion acts as an intermediary between the Web page server and the ODBC driver manager. This allows a developer to write Web pages that include SQL statements that can bring data out of the database to be presented, or processed in some way. This processing might include adding or updating data to the database, or manipulating the data in some way to produce information for presentation to a user, whether this user is a senior manager or not. Each user is a client who should be presented useful information in a usable format.

V. CONCLUSION AND RECOMMENDATIONS

A. CONCLUSION

Knowledge of usability of Web based information tools by senior managers holds value for designers of Web pages and sites, as well as the users of those applications. By knowing what to expect and demand, users can shape the future of these designs, and by knowing what users want and desire in a Web based application, designers can provide systems that are usable and effective.

The literature review found, and the surveys and observation proved, that content is indeed king to users of Web applications. It is irrelevant if a developer follows all of the usability guides; if the content on a page is lacking, the user will look elsewhere. For this reason, it is imperative that writers aim documents specifically at the electronic medium of the World Wide Web. The importance of keeping the information on a site correct and current can not be over emphasized, as it lends to the quality and credibility of the site.

Web linking was an issue that presented itself during this study. If information about an item is available elsewhere on the Web, a link can and should be used. This takes advantage of one of the strengths of the World Wide Web. Benefits of this practice include allowing someone else to own and maintain their information, reducing workload on an organization's technical staff, saving valuable time, and reducing redundancy and sources of data error, inconsistency, inaccuracy, timeliness, etc. However, before installing a link on their site, developers must review the content of the information contained in the page that has been linked to ensure accuracy, to the best of their ability.

A set of decision criteria should be set up to determine whether to include links whose information is not completely accurate. Including these links on a site may increase richness of a site, but may also sacrifice credibility of the "referring" site. The aforementioned decision criteria must address this issue. Broken or incorrect links are one supporting argument for continuous "gardening" or maintaining of Web sites, and is highly recommended.

Another point to take away from this thesis is that the purpose of the Web site must remain clear to the designers and maintainers. The target audience for the Web application must be identified and queried as to what they find useful. The design must be tested on actual users to determine if their needs are being met.

Simplicity is essential. Pages free from complex graphics or blinking or scrolling text will not distract the user when viewing the page, and it will help ensure reasonable download times. By following the guidelines set forth in this thesis, a designer can assemble a Web site that keeps its users in mind by designing specifically for them. Internet or intranet Web sites have the potential to provide easily accessible information to those who need it, in the most timely manner possible.

Information must be extrapolated from data contained in databases. Connection of a database to a Web application is key in obtaining this goal of providing useful information. Developers must simply be aware of the challenge and purchase products that are ODBC compliant, so that a DBMS and an application requesting data can communicate to provide this useful information.

B. RECOMMENDATIONS

The information obtained from the literature review and the insight gained from the surveys and observation lead to several suggestions. These concluding statements should provide the stimulus for changes supported by the collated data.

The main suggestion entails migrating the CEE Web site to a modified version of the model presented in Sample Two of the project created for this thesis. Suggested modifications include:

- Amount of graphics on CEE site good, but add no more;
- Move navigation buttons to tops of pages, and reduce their size;
- Use standard link colors;
- Decrease the amount of scrolling required per page without sacrificing content;
- Provide security for privacy act type data (beyond the scope of this thesis);
- Ensure all content on the site is current and accurate (i.e. biographies are available to participants of the course);
- Opinion forms: make it more obvious which forms have been completed by making the colors more obvious for links that have been followed or including check boxes on the main opinion form selection page for those forms that have been completed.

1. Suggested Further Studies

The lack of literature in this area suggests a fertile area to be probed by future researchers. Additional bodies of data, large enough to be statistically significant should

be gathered and analyzed. Continued surveying with the current surveys, or a similar updated survey of this type, would provide further insight into the senior manager as a user of these systems. Additional questions to be added to the survey may be to ascertain the average senior managers' years of experience using a computer to establish a baseline for this group, and another to attempt to determine how advanced this subset of users are, on average.

A study relating the effects of linked information should be performed. This study should attempt to determine whether users prefer links to information that may not be entirely accurate, or not link at all. It could also explore the effects of linked information on the referring Web site.

Another interesting project would be to continue to survey participants of the courses taught by the Center for Executive Education. Identical surveys could be given before and after attendance of the course to determine the effectiveness of the courses.

APPENDIX A. GENERAL WEB SURVEY

Please read the following before continuing...

Information gained by this survey will be used in a thesis aimed at creating better Web interface design for senior managers. Accurate information is essential to developing an accurate profile for senior managers. Feedback will also be integrated into the CEE Web site. The information obtained will also allow us to profile the typical user at the senior management level. The information obtained in this survey is and will remain anonymous; no names will be taken or associated in any way to the information gained.

This survey should take approximately 10 to 15 minutes to complete.

Thank you for taking the time to participate.

Please answer the following questions to the best of your knowledge:

1. How many hours per day, on average, do you spend at work?
2. How many hours per day, on average, do you spend on work related activities **in addition to** the hours noted in Question 1?
3. I use a computer at (please check all that apply): Home Work Mobile
4. I use (please check all that apply):
 a PC a Macintosh a Notebook a Palm Top
 Windows 95 Windows NT Server Windows NT Workstation
 Netscape Browser Microsoft (MS) Internet Explorer Browser Unix Workstation
 MS Office 95 or 97 Secure network (SIPRNET) Unclassified machines (NIPRNET)
5. What types of activities do you perform on computers (please check all that apply, whether at work or at home):

<input type="checkbox"/> E-mail	<input type="checkbox"/> Presentation Graphics (i.e. Power Point, etc.)
<input type="checkbox"/> Word Processing	<input type="checkbox"/> DoD Applications (Financial, Supply, Travel Manager, etc.)
<input type="checkbox"/> Web Access / Browsing	<input type="checkbox"/> Spread sheet (Excel, Lotus 1-2-3, etc.)
<input type="checkbox"/> Games	<input type="checkbox"/> Financial Programs (Quicken, MS Money, etc.)
<input type="checkbox"/> Other (please write in): <input type="text"/>	

E-Mail:

6. With respect to E-mail, how many accounts do you have:
Navy account(s) Private account(s) (i.e. AOL, MSN, etc.)
7. On an average workday, how many E-mail messages do you receive (not counting leave)? How many of these messages have attachments?
How many of these are you **not** able read (for any reason)?
8. Approximately how much time per day, on average, do you spend generating, reading, and responding to E-mail?
 0-15 minutes 16-60 minutes 1-3 hours More than 3 hours

Internet:

9. In total, approximately how much time per day, on average, do you spend on the Internet (i.e. Browsing or searching the web) for any purpose?
 0-30 minutes 30-60 minutes 1-3 hours More than 3 hours

10. Approximately how often do you Browse or Search the Web?

Several times daily Once daily Less than five times per week
 Less than ten times per month Never

11. When you get to a Web site, how long do you stay there?

0-2 minutes 2-10 minutes 10-30 minutes More than 30 minutes

12. When you are finished looking at a Web site, do you (rank in order, with 1 being most used action):

Follow a query-retrieved suggestion (i.e. go back to a search engine and follow a link from there)
 Jump to another Web site without using a link
 Follow a link to another Web site Close the browser N/A, I do not access the Web

13. Regarding the graphical user interface used on Web sites you visit, what do you find most detracting? (Rank in order, with 1 being most detracting)

Long download times Counter intuitive links
 Long scrolling pages Lack of navigation support
 Scrolling text, marquees, ads, constantly running animations

Non-standard link colors
 Poor color schemes
 Other, please write below

Completely Disagree
Generally Disagree
Neutral
Generally Agree
Completely Agree

14. The complexity of a Web site's address discourages me from visiting/using that site.....

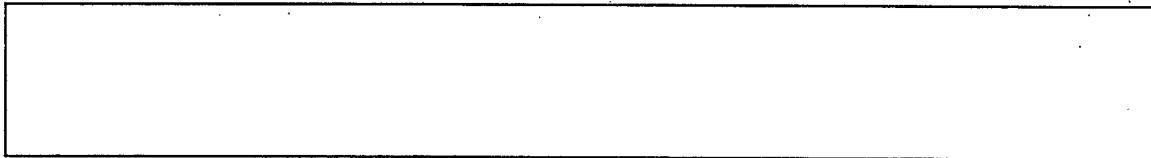
15. Computers make me more productive.....

16. Computers increase the number of tasks I must complete to the extent that I experience increased workload.....

17. Expanded use of E-mail would make me more effective/efficient...

18. List 3 Web sites you like and give the reason(s) you like each one (you do not have to use the exact address) (NOTE: If you can not think of 3 sites, please list 3 features you like about Web sites):

19. List 3 Web sites you do **not** like and give the reason(s) for each (you do not have to use the exact address) (NOTE: If you can not think of 3 sites, please list 3 features you like about Web sites):



Note: This survey came out to three total pages in finished form. Due to formatting differences here it increased to four pages.

APPENDIX B. CEE SITE SPECIFIC WEB SURVEY

Section I - General

Regarding the CEE Web site, please respond to each of the following:

1. Information on the site is relevant:
2. Information on the site is accurate:
3. Information on the site is complete:
4. Information on the site is current:
5. Information on the site meets my needs:
6. Information on the site is intuitive:
7. Information on the site is easily readable:
8. The site address is too complex:
9. The amount of page scrolling is acceptable:
10. The link colors are acceptable:
11. The colors used throughout the site are acceptable:
12. The amount of graphics is acceptable:
13. I would like to see more graphics:
14. Download times are acceptable:
15. Navigation support is acceptable:
16. Navigation through the site is intuitive:

Completely Agree	Generally Agree	Neutral	Generally Disagree	Completely Disagree
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Section II - Interactive

Please answer the next set of questions regarding the following graphical user interfaces:

Go to the LCIA Page:

17. Which of the samples do you prefer? 1 2 Which is more readable? 1 2
Which is more intuitive? 1 2

18. Which sample makes it easier to obtain information about the LCIA Program? 1 2

Go to the Content Overview Page (What or About LCIA):

19. Which of the samples do you prefer? 1 2 Which is more readable? 1 2
Which is more intuitive? 1 2

20. Which sample makes it easier to obtain information about cost? 1 2

Go to the Course Registration Form:

21. Which sample page made it easier to navigate from the "Content Overview Page" to the "Course Registration Form"? 1 2 Why?
22. Which sample page is easier to navigate? 1 2
23. Which sample registration form is easier to use? 1 2
24. Which form layout do you prefer? 1 2 Which is more readable? 1 2
Which is more intuitive? 1 2
25. For the 'Rank' and 'Service' boxes, which is easier to use? 1 2
Which do you prefer? 1 2
26. Would you prefer "drop boxes" for the state entries? Yes No

27. Which view of the "About LCIA" (or "Content Overview Page") from sample 2 do you prefer?

As viewed in MS Internet Explorer
Communicator

As viewed in Netscape
Communicator

28. Would you like to see the schedules presented differently? Yes No
If Yes, how?

29. Regarding the graphical user interface used on the CEE Web site, what do you find most detracting?

30. What changes would you make to the CEE Web site (additions or deletions)? Please specify below.

APPENDIX C. GENERAL WEB SURVEY DATA

Summary N=9

Please answer the following questions to the best of your knowledge:

1. How many hours per day, on average, do you spend at work?

Raw answers: 12, 11, 12 (60), 10, 12.5, 12, 10, 10, 10

Range: Low: 10 High: 12.5

Mean: 11.06 hours per day

(Special Note: one participant responded with an answer of 60 hours. When compiling the data, a reasonable assumption was made to divide this by 5 for an average of 12 hours worked per day. With that response thrown out, the Mean becomes 10.94 hours per day.)

2. How many hours per day, on average, do you spend on work related activities in addition to the hours noted in Question 1?

Raw answers: 2, 2, 1, 1, 1, 1 to 2, 1, 2, 2

Range: Low: 1 High: 2

Mean: 1.5 hours per day

(Special Note: one participant responded with a range of 1 to 2 hours. When compiling the data, this response was averaged and 1.5 was used to calculate the mean for this question. With this response thrown out, the Mean remains 1.5 hours per day.)

3. I use a computer at (please check all that apply): Home Work Mobile

Responses: 8 9 7

4. I use (please check all that apply): **Responses:**

A PC	9
A Macintosh	3
A Notebook	4
A Palm Top	2
Windows 95	7
Windows NT Server	4
Windows NT Workstation	3
Netscape Browser	5
Microsoft (MS) Internet Explorer Browser	6
Unix Workstation	0
MS Office 95 or 97	7
Secure network (SIPRNET)	5
Unclassified machines (NIPRNET)	6

5. What types of activities do you perform on computers (please check all that apply, whether at work or at home):

	Responses:
E-mail	9
Word Processing	8
Web Access / Browsing	9
Presentation Graphics (i.e. Power Point, etc.)	8
DoD Applications (Financial, Supply, Travel Manager, etc.)	1
Spread sheet (Excel, Lotus 1-2-3, etc.)	4
Financial Programs (Quicken, MS Money, etc.)	5
Games	6
Other (please write in):	4

- **FOCIS – Management Package**
- **Learn to play piano**
- **E-Commerce/HR Application**
- **Financial transactions**

E-Mail:

6. With respect to E-mail, how many accounts do you have:
Navy account(s)

Raw answers: 2, 1, 1, 1, 2, 2, 2, 2, 2

Range: Low: 1 High: 2

Mean: 1.67 Navy E-mail accounts per person

Private account(s) (i.e. AOL, MSN, etc.)

Raw answers: 0, 1, 1, 1, 0, 1, 1, 0, 1

Range: Low: 0 High: 1

Mean: 0.67 Private E-mail accounts per person

7. On an average workday, how many E-mail messages do you receive (not counting leave)?

Raw answers: 45, 50, 10, 30, 50, 12, 30, 30, 10

Range: Low: 10 High: 50

Mean: 29.67 Messages per person per day

How many of these messages have attachments?

Raw answers: 10, 5, 20, 15, 30, 3, 10, 5, 3

Range: Low: 3 High: 30

Mean: 11.22 Attachments per person per day

How many of these are you **not** able read (for any reason)?

Raw answers: 3, 1, 1, 1, 1, 0, 1, 1, 0

Range: Low: 0 High: 3

Mean: 1.00 Unreadable attachments per person per day

8. Approximately how much time per day, on average, do you spend generating, reading, and responding to E-mail?

Responses:

0-15 minutes

16-60 minutes 4

1-3 hours 5

More than 3 hours

Internet:

9. In total, approximately how much time per day, on average, do you spend on the Internet (i.e. Browsing or searching the web) for any purpose?

Responses:

0-30 minutes 4

30-60 minutes 4

1-3 hours 1

More than 3 hours

10. Approximately how often do you Browse or Search the Web?

Responses:

Several times daily	4
Once daily	3
Less than five times per week	2
Less than ten times per month	
Never	

11. When you get to a Web site, how long do you stay there?

Responses:

0-2 minutes	1
2-10 minutes	7
10-30 minutes	1
More than 30 minutes	

12. When you are finished looking at a Web site, do you (rank in order, with 1 being most used action):

Key (in bold):

- A. Follow a query-retrieved suggestion (i.e. go back to a search engine and follow a link from there)
- B. Jump to another Web site without using a link
- C. Follow a link to another Web site
- D. Close the browser
- E. N/A, I do not access the Web

Outcome:

Method	1	2	3	4	5	6	7	8	9	Mean Rank	Overall Rank
Follow a query-retrieved suggestion	4	2	3		2			4	3	3.00	4
Jump to another Web site without using a link	1	3	4		1		1	2	1	1.86	1
Follow a link to another Web site	2	1	2		3	1		3	2	2.00	2
Close the browser	3	4	1	1	4			1	4	2.57	3
N/A, I do not access the Web	*	*	*	*	*	*	*	*	*	*	*

***(Can be thrown out – no responses)**

(Special Note: the above mean rank includes the responses where the participant only checked one block vice ranking them in the order as requested. The checked boxes were counted as #1, with no other responses being posted. Throwing these responses out had no effect on the overall ranking. Mean rank for the data if the 3 participants' data in question are left out are as follows: A = 3.00, B = 2.00, C = 2.167, and D = 2.83)

13. Regarding the graphical user interface used on Web sites you visit, what do you find most detracting? (Rank in order, with 1 being most detracting)

Outcome:

Detractor	1	2	3	4	5	6	7	8	9	Mean Rank	Overall Rank
Long download times	1	2	1	1	3	1	2	1	2	1.56	1
Long scrolling pages	2	3	2	6	1	3	3	2	3	2.78	3
Scrolling text, marquees, ads, constantly running animations	3	1	5	5	6	5	7	7	1	4.44	6
Counter intuitive links	4	4	3	4	2	2	6	4	4	3.67	4
Lack of navigation support	5	6	4	3	4	4	1	3	5	3.89	5
Non-standard link colors	6	7	6	7	5	6	5	5	6	5.89	7
Poor color schemes	7	5	7	8	7	7	4	6	7	6.44	8
Other, please write below				2						2.00	2

Other = Broken links

Completely Agree	5
Generally Agree	3
Neutral	6
Completely Disagree	1

14. The complexity of a Web site's address discourages me from visiting/using that site..... 3 5 1

15. Computers make me more productive..... 3 6

16. Computers increase the number of tasks I must complete to the extent that I experience increased workload..... 3 2 3 1

17. Expanded use of E-mail would make me more effective/efficient..... 1 5 2 1

18. List 3 Web sites you like and give the reason(s) you like each one (you do not have to use the exact address) (NOTE: If you can not think of 3 sites, please list 3 features you like about Web sites):

- **Snap! News, top stories door = quick, comprehensive info**
- **The Weather Channel = quick, comprehensive info**
- **ZDnet Anchor Desk = good access to IT news**
- **NUWCNET – work home page with useful info**
- **Dictionary & thesaurus – useful and easy to use**
- **Dilbert – mood lifting, easy**
- **Travel Manager**
- **Business News/Stock quotes**
- **Military home pages**
- **CEOexpress – Meta site**
- **Alta Vista – go find it**
- **WashingtonPost.com – best news on the Net**
- **CEOexpress.com – quick info/quick links to related sites**
- **DefenseLink.mil – quick info/quick links to related sites**
- **Anchordesk.com – quick info/quick links to related sites**
- **CEOexpress**
- **AOL**
- **CNN**
- **Cnn.com – latest news**
- **CEOexpress.com – best meta links**
- **Wired.com – good tech stuff**
- **...CEO... – great homepage to jump off from**
- **...schwab... - investments/trading**
- **...quicken... - stock quotes/graphs**
- **CEOexpress – excellent links**
- **BUPERSnet – potential high for info pertinent to me**
- **HOTBOT – access to good info**

19. List 3 Web sites you do not like and give the reason(s) for each (you do not have to use the exact address) (NOTE: If you can not think of 3 sites, please list 3 features you like about Web sites):

- **Search engines = low yield**
- **Travel – very hard to find what I want**
- **E-bird – bad scrolling**
- **Broken links**
- **Promise, but no substance**
- **Gratuitous graphics**
- **Most news sites – Not interactive**
- **IETF.ORG – too technical**
- **Airlines – too much time required**
- **Shopping – Eddie Bauer – too hard, not user-friendly**
- **Interlotto.com – too complicated**
- **NY Times – have to subscribe**
- **FlagWeb – not real current**
- **(LIKE) – Not too much advertising content on the screen**
- **(LIKE) – Ease of use – Intuitive**
- **(LIKE) – Connected/Hyperlinked**
- **BUPERSnet – potential high, but frequently does not deliver**

APPENDIX D. CEE SITE SPECIFIC WEB SURVEY DATA

Summary **N=9**

Section I - General

Regarding the CEE Web site, please respond to each of the following:

	Completely Agree	Generally Agree	Neutral	Generally Disagree	Completely Disagree
--	------------------	-----------------	---------	--------------------	---------------------

1. Information on the site is relevant:	5	4			
2. Information on the site is accurate:	3	4	2		
3. Information on the site is complete:	3	4	1		1
4. Information on the site is current:	3	2	3	1	
5. Information on the site meets my needs:	3	6			
6. Information on the site is intuitive:	4	2	2	1	
7. Information on the site is easily readable:	6	3			
8. The site address is too complex:	1	1		3	4
9. The amount of page scrolling is acceptable:	1	5	2		1
10. The link colors are acceptable:	2	5		1	1
11. The colors used throughout the site are acceptable:	2	6			1
12. The amount of graphics is acceptable:	1	4	3		1
13. I would like to see more graphics:	1	3	3	2	
14. Download times are acceptable:	3	5	1		
15. Navigation support is acceptable:	5	3	1		
16. Navigation through the site is intuitive:	3	4	2		

Section II - Interactive

Please answer the next set of questions regarding the following graphical user interfaces:

Go to the LCIA Page:	S1	S2
17. Which of the samples do you prefer?	2	7
Which is more readable?	3	6
Which is more intuitive?	3	6
18. Which sample makes it easier to obtain information about the LCIA Program?	3	6

Go to the Content Overview Page (What or About LCIA):	S1	S2
--	-----------	-----------

19. Which of the samples do you prefer?	1	8
Which is more readable?	1	8
Which is more intuitive?	0	9
20. Which sample makes it easier to obtain information about cost?	0	9

Go to the Course Registration Form:	S1	S2
--	-----------	-----------

21. Which sample page made it easier to navigate from the "Content Overview Page" to the "Course Registration Form"?	2	6
Why? - One answer: Equally Bad		

Other comments:

- 2 - Easier to read and more intuitive
- 2 - Obvious selection
- Equally bad - No direct link
- 2 - Less scrolling/more intuitive
- 2 - Registration icon
- 2 - Nav[igation] Bar takes you to "Register" - #1 requires search
- 1 - One less click
- 2 - Easier to navigate from "buttons" than [from] narrative text
- 1 - Seems to be fewer steps to get there. More readily, easily available

22. Which sample page is easier to navigate?	3	6
--	---	---

Other comments:

- 2 - Less scrolling

23. Which sample registration form is easier to use?	3	6
--	---	---

Other comments:

- Bolder boxes

24. Which form layout do you prefer?	3	6
--------------------------------------	---	---

Which is more readable?	2	7
-------------------------	---	---

Which is more intuitive? One "Same"	1	7
--	---	---

25. For the 'Rank' and 'Service' boxes, which is easier to use?	0	9
---	---	---

Which do you prefer?	0	9
----------------------	---	---

Yes	No
------------	-----------

26. Would you prefer "drop boxes" for the state entries?	2	7
--	---	---

Other comments:

- Too many entries to scroll through
- List too long
- I can easily type two letters

27. Which view of the "About LCIA" (or "Content Overview Page") from sample 2 do you prefer?

As viewed in MS Internet Explore

9

As viewed in Netscape Communicator

0

Note: The only difference between these pages was the font (Arial vs. Times New Roman)

Comments:

- **MSIE - bigger type**
- **(Note: One of the participants liked the buttons better in Netscape Communicator – even though the font size was smaller – when asked directly to concentrate only on the page content , without considering the browser application itself, the participant liked the MSIE version better.**
- **Font (Note: This participant liked the font in MSIE better)**

28. Would you like to see the schedules presented differently?
If Yes, how?

Yes	No
1	8

29. Regarding the graphical user interface used on the CEE Web site, what do you find most distracting?

Comments:

- **Like simple stuff, no "bells and whistles"**
- **Like input, needs to be intuitively obvious**
- **Scrolling – would be nice if it fit on one page**
- **Small type size/too much scrolling**
- **I don't find anything distracting. Colors, etc. do not bother me – it's content**
- **Disjointed – seems a little "hodgepodge" – thrown together**
- **Emphasis on Blue color – would like to see more variation**
- **Missing [some] bios in faculty section**
- **After entering the information on the participant opinion forms, would like to be locked out so that I know that I have already voted on that day's activities**

30. What changes would you make to the CEE Web site (additions or deletions)? Please specify below.

Comments:

- Bios not there for all presenters
- Like opinion forms
- Like to go in, get info, get out
- More obvious color choices to which evaluation have been completed (Note: hard to tell which links have already been followed – especially on the machines used in the experiment, which were laptops.)
- Why list Topsail – It is ‘under construction’? (You click on it and it tells you there is no class scheduled for 1998)
- Larger type/More intuitive links (HTTP)
- I’m happy with it
- Use Nav bars as in Sample 2
- Uniformity/same feel
- Click on a bullet to next link
- Opinion forms – Automatically go to today’s date
- Maintain history of previous opinion form answers
- Decrease scrolling
- Put more [heavily] used choices at or near top of page
- [Put] Early Bird on external links
- I like the wealth of info added on Sample 2...The more the better. On the current site, it looks like more info is available tan really is.

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